

## Chapter (1.4 + 3.3): Problem Solving in Chemistry

### 3.3 Conversion Problems (pg. 80-87)

1. Apply dimensional analysis as a mathematical tool.
2. Use conversion factors in a factor label solution to problems.
3. Do multistep problems with simple and complex units.
4. Show clear, stepwise solutions to complex problems.

### Section 1.4: Problem Solving in Chemistry (pg. 28-32)

1. Apply a systematic approach to solving numeric problems.
2. Translate data from word problems into clear, coherent mathematical solutions.

### Written Work

p. 34-36 # 59, 60, 61, 71, 76, 80, 81 (revise from chapter 1), 82, 83

p. 96-98 # 71, 73, 79, 84, 88, 89, 91, 93, 94, 96, 103, 104, 107

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Take a problem solving test (5 word problems, must show elegant solutions)

## Problem Solving Reference Page

Substance	Density (g/cm <sup>3</sup> )	Formulas
Gold	19.3	$V_{\text{box}} = L \times W \times H$
Lead	11.4	$V_{\text{sphere}} = \frac{4}{3} \pi r^3$
Silver	10.5	$V_{\text{pyramid}} = \frac{1}{3} (L \times W \times H)$
Pyrite	5.0	$V_{\text{cylinder}} = \pi r^2 L$
Platinum	21.5	

## Conversion Factors

16 ounces = 1 pound	2000 pounds = 1 ton
2.2 pounds = 1 kilogram	1 troy ounce = 31.1 grams
1000 grams = 1 kilogram	1 L = 1.1 quart
1000 ml = 1000 cm <sup>3</sup> = 1 L	1 Liter = 61.02 cubic inches
4 quarts = 1 gallon	1 cubic foot = 2.83 x 10 <sup>4</sup> cm <sup>3</sup>
1 fluid ounce = 29.573 mL	2.54 centimeters = 1 inch
12 inches = 1 ft	1 ft = 30.480 centimeters

# WS 1.6 Dimensional Analysis (CONVERSIONS)

This may be the most important worksheet of the semester.

example A: 29.5 in  $\rightarrow$  ft:  $29.5 \cancel{\text{in}} \times \frac{1 \text{ ft}}{12 \cancel{\text{in}}} = 2.46 \text{ ft}$

example B: 0.036 m  $\rightarrow$  in:  $0.036 \cancel{\text{m}} \times \frac{100 \cancel{\text{cm}}}{1 \cancel{\text{m}}} \times \frac{1 \text{ in}}{2.54 \cancel{\text{cm}}} = 1.4 \text{ in}$

1) 2.45 ft  $\rightarrow$  mi

2) 75.0 kg  $\rightarrow$  lb

3) 10.0 gal  $\rightarrow$  mL

4) 89 km  $\rightarrow$  in

example C: 5.17 lb/gal  $\rightarrow$  lb/qt:  $5.17 \frac{\text{lb}}{\cancel{\text{gal}}} \times \frac{1 \cancel{\text{gal}}}{4 \text{ qt}} = 1.29 \text{ lb/qt}$

example D: 3.4 mi/hr  $\rightarrow$  km/min:  $3.4 \frac{\cancel{\text{mi}}}{\cancel{\text{hr}}} \times \frac{1.61 \text{ km}}{1 \cancel{\text{mi}}} \times \frac{1 \cancel{\text{hr}}}{60 \text{ min}} = 9.1 \times 10^{-2} \text{ km/min}$

5) 459 ft/sec  $\rightarrow$  mi/hr

6) 2.40 g/mL  $\rightarrow$  lb/gal

7) 32.56 km/hr  $\rightarrow$  ft/hr

example E: 3.9 cm<sup>3</sup>  $\rightarrow$  ft<sup>3</sup>:  $3.9 \text{ cm}^3 \times \left( \frac{1 \cancel{\text{in}}}{2.54 \cancel{\text{cm}}} \right)^3 \times \left( \frac{1 \text{ ft}}{12 \cancel{\text{in}}} \right)^3 = 1.4 \times 10^{-4} \text{ ft}^3$

8) 5800 mi<sup>2</sup>  $\rightarrow$  km<sup>2</sup>

9) 35.2 ft<sup>2</sup>  $\rightarrow$  cm<sup>2</sup>

1 ft = 12 in  
1 mi = 5280 ft  
1 lb = 16 oz  
1 gal = 4 qt

1 in = 2.54 cm  
1 mi = 1.61 km  
1 lb = 454 g  
1 L = 1.057 qt

1 m = 100 cm  
1 km = 1000 m  
1 kg = 1000 g  
1 L = 1000 mL  
1 mL = 1 cm<sup>3</sup>

**ANS (IRO+2):** 0.000464 165 107,000 22.4 32,700 15,000 313 220. 3,500,000 20.0  
37,800

**UNITS (IRO+2):** km<sup>2</sup> mL lb/gal mi ft/hr cm<sup>2</sup> in mi/hr lb kg lb/ft<sup>3</sup>

## Practice Problems

### Factor Label Problem Solving

Name: \_\_\_\_\_

The following equalities might be necessary in some of the problems on this worksheet.

$$2.54 \text{ cm} = 1.00 \text{ in}$$

$$454 \text{ g} = 1.00 \text{ lb}$$

$$1.00 \text{ Angstrom (A}^\circ\text{)} = 1 \times 10^{-8} \text{ cm}$$

$$3 \text{ ft} = 1 \text{ yard}$$

$$12 \text{ inches} = 1 \text{ ft}$$

Please SHOW ALL WORK using the factor label method!!! Do not forget units!!!!

1. How many dimes are in 56 dollars? How many pennies? (ans. = 5600 pennies)
2. How many nickels are there in 6 quarters? (ans. = 30 nickels)
3. How many hours, minutes and seconds are in 3 weeks? (ans. = 504 hrs, 30240 min, 1814400 sec)
4. Convert 17 pounds to grams. (ans. =  $7.7 \times 10^3 \text{ g}$ )
5. How many centimeters are in 254 inches? (ans. = 645 cm)
6. 50.0 yards contain how many feet? (ans. = 150 ft)
7. Convert 540 mm to kilometers. (ans. =  $5.40 \times 10^{-4} \text{ km}$ )
8. How many centimeters are there in 2.0 feet? (ans. = 61 cm)
9. Convert 150 feet to Angstroms. (ans. =  $4.57 \times 10^{11} \text{ A}^\circ$ )

### Factor Label Word Problems

1. If your heart pumps blood at a rate of 6.8 fluid ounces per second, then what is this rate in gallons per hour (1 quart = 32 fluid ounces)
2. The fastest recorded hard baseball pitch is allegedly 108 mph. What is this in m/s?  
(1 mile = 5280 feet)
3. A cube of gold is 4.02cm on each side. What is its mass in grams?
4. In order to earn \$42,000 per year, how much per hour must your salary be? Assume that you work 50 weeks per year, 5 days per week, 8 hours per day.
5. An exchange student lands on Mars and finds a chemical supply house. She needs 140 grams of dilithium crystals to continue her experiments. The Martian supplier asks her, "How many zoops of dilithium do you need?" She thinks, "Oh no, Mrs. Pav was right! I have to do unit conversions." She refers to her super-electronic memory enhancer and finds out the following:

9 poofs (pf) = 1 gram (g)	2 fings (fn) = 7 warps (wp)
8 poofs = 3 warps	4 zoops (zp) = 3 fings

How many zoops did she finally request?

6. A car going 15 miles per hour is traveling how many meters per second?  
(1km = 0.621miles)

### Challenging Factor Label Problems

1. When 121g of sulfuric acid are added to  $4.00 \times 10^2$  mL of water (at  $4^\circ\text{C}$ ), the resulting solution's volume is 437mL. What is the density of the resulting solution?
2. The density of dry air at  $20^\circ\text{C}$  is 1.20g/L. What is the mass of air, in kilograms, in a rectangular room that measures 25.0m x 15.0m x 4.0m?
3. Indiana Jones, at the beginning of the Raiders of the Lost Ark, finds an ancient solid gold idol in a South American jungle cave. The idol appears to have a volume of 1.5L. What weight of sand in pounds would Indiana Jones need in order to replace the idol on its booby-trapped pedestal? What volume in Liters is the sand?

4. A farmer raised 50 goats. He went to the marketplace with \$100.00 and traded the goats for sheep at a rate of 5 goats for every sheep. Then he traded the sheep for hogs at a rate of 4 sheep for 2 hogs each weighing 250 lbs. Finally, he traded the hogs for the going rate of \$55.00 per 100 lbs. How much money did the farmer take home?

5. A student measures a spherical balloon with a string and determines its circumference to be 64.0 cm. The balloon happens to be filled with  $\text{CO}_2$  gas. Calculate the following:

(a) The volume of the balloon in  $\text{m}^3$ .

(b) The mass of the balloon in pounds.

*(The density of  $\text{CO}_2$  is 1.80g/L; circumference =  $\pi d$ ;  $r = \frac{1}{2} d$ ;  $V_{\text{sphere}} = \frac{4}{3} \pi r^3$ )*

6. Chlorine is the most abundant element in seawater. Normal seawater has a density of 1.0 g/mL and contains 19,000mg of chlorine per liter. How much chlorine ( in kg) is in a sample of seawater that has a mass of 1580g?

7. The United States produces about 380,000 metric tons of aluminum per month. If the density of aluminum is  $2.7\text{g/cm}^3$ , how many cubic centimeters of aluminum does this represent?  
(1 metric ton = 2200 lbs)
8. The density of lead is  $11. \text{g/cm}^3$ , and you have a 50.0lb rectangular sheet of the metal. Two sides are measured to be 3.0cm and 4.0cm. What is the length, in feet, of the sheet?

#### More Challenging Factor Label Problems

1. You and two friends decide to go to Mexico City from El Paso, TX where y'all live. You volunteer your car if everyone chips in for gas. Someone asks how much the gas will cost per person on a round trip. Your first step is to call your smarter brother to see if he'll figure it out for you. Naturally he's too busy to bother, but he does tell you that it is 2015 km to Mexico City, there's 11 cents to the peso, and gas costs 5.8 pesos per liter in Mexico. You know your car gets 21 miles to the gallon, but we still don't have a clue as to how much the trip is going to cost each person in dollars. (1mi = 1.6 km)



- An average man requires about 200mg of riboflavin (vitamin B2) per day. How many tablespoons of cheese would a man have to eat each day if this was the only source of riboflavin and if mozzarella cheese contained 5.5 mg. of riboflavin per gram? The density of mozzarella cheese is 68.93 grams per dL. (1TBS = 15mL)
- If 1.0g of silver can be converted into 400.0 square feet of mirrors, how thick is the coating in millimeters. The density of silver is 105 dg/cm<sup>3</sup>.
- The diameter of metal wire is often referred to by its American wire gauge number. A 20-gauge wire has a diameter of 0.03196 inches. How many meters of wire are present in a 3.0 pound spool of 20-gauge copper wire? The density of copper is 8.92 g per mL. (volume of a cylinder =  $\pi r^2 l$  where l=length)
- It is known that 400.0 pounds of iron metal occupy a volume of 0.02234 cubic meters. Calculate the radius in meters of an iron sphere that has been determined to contain 54.5 kilograms of iron.